# The Impact of ChatGPT on Student Learning/performing

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***Abstract*— This paper explores the integration of ChatGPT, an AI-based language model, in undergraduate education. The study examines the potential benefits, challenges, and ethical considerations associated with incorporating ChatGPT into teaching and learning practices. It investigates the impact of ChatGPT on student engagement, critical thinking, and problem-solving skills, as well as its potential to enhance writing skills and provide personalized learning experiences. The survey conducted on faculty staff at a university reveals their perspectives on using ChatGPT, including its effects on learning outcomes and performance. Additionally, the paper addresses concerns related to biases in AI-generated content, privacy issues, copyright considerations, and the importance of balancing AI use with traditional teaching approaches. The findings emphasize the need for responsible implementation, faculty training, and ongoing evaluation to maximize the benefits of ChatGPT while upholding ethical practices in education. Overall, this paper sheds light on the potential of ChatGPT as a valuable tool in undergraduate education while highlighting the importance of maintaining critical thinking skills and human interaction in the learning process.**

***Keywords—ChatGPT, AI, Education, Plagiarism, Assessment***

## I. INTRODUCTION

We are living in a new global era led by artificial intelligence (AI), whose manifestations are accelerating at a frightening, if not terrifying, pace. Even the poles of the technology driving it, called for a truce to understand and catch a breath. Nowadays, so-called Chatbots are widely used. They are computer programs that use AI and natural language processing (NLP) to understand human requests and automate responses to them and adapt to users through the data they have collected. The most notable of which is ChatGPT.

Chat GPT is an abbreviation for generative pre-trained transformer. It is a new artificial intelligence technology that was made available in November 2022[1]. This tool responds to inquiries in a conversational manner. Chat GPT is one of several AI techniques that comprise the big language model. Developed by Open AI, it can produce outlines, poetry, letters, advice, cover letters, resumes, and even blog posts for this website. ChatGPT can provide logical and fluid replies to a variety of inquiries and prompts since it has been trained on a vast quantity of text data[2]. It can make research and learning more efficient. Through an internet browser, anyone may communicate with ChatGPT. ChatGPT reacts to a question or prompt that has been posted.

ChatGPT is utilized for a variety of purposes, such as chatbots and virtual assistants, providing human-like conversation. Unlike search engines like Google, ChatGPT is a language generation model mostly used to produce text, e.g., conversation responses or descriptions in natural language[3].

The education community has had conflicting feelings about Chat GPT. As students utilize recent technology to cheat on essays, exams, and assignments, some educators have become alarmed. others are approaching it more liberally and think it has the potential to revolutionize education by helping students become better writers, thinkers, and learners.

Before calculators, the answer was frequently all that mattered; however, once calculators were introduced, it became crucial to demonstrate how you had solved the problem. Some experts have proposed that a similar thing could happen with academic essays, where they are now evaluated not only on what they say but also on how students edit and improve a text generated by an AI.

Similar circumstances emerged as internet search engines gained popularity. Search engines were feared to have a long-term negative impact on pupils' reading and learning habits. Book sales fell, and several bookshops closed their doors globally. However, as civilization advanced, novel reading devices like smartphones and e-readers became popular. Use Chat GPT to get the answers to challenging questions. In summary, Chat GPT offers consumers well-researched, well-expressed human-like solutions to their text-based questions, in contrast to Google Search, which focuses on assisting users in finding information on the web[4].

The influence of ChatGPT on higher education depends on how and to what extent it's employed. It may serve as a tool to enhance teaching and learning but could also hinder students' motivation and focus. Furthermore, like other AI systems, using ChatGPT for educational purposes raises ethical considerations[5].

## II. WHAT IS CHATGPT

Chat Generative Pre-Trained Transformer (ChatGPT) is a 175-billion-parameter natural language processing model that can generate conversation-style responses to user input. ChatGPT is a natural language processing (NLP) model that generates human-like text responses using a variant of the popular Transformer network. It's trained on large amounts of text data, allowing it to understand the patterns of human language and produce convincing text.

It's worth mentioning that ChatGPT is not a search engine like Google or Bing. Rather, it is a language generation model that is mostly used to produce text, such as conversation responses or descriptions of images in natural language[6]. In contrast, search engines are tools that allow users to search the Internet by accessing and querying a database of websites.

One significant difference between ChatGPT and other NLP models is training. ChatGPT is designed specifically to generate human-like text responses, while other NLP models may be trained on diverse data or for varying objectives, such as sentiment analysis or language translation.

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Furthermore, other NLP models could use different network architectures, such as RNNs or CNNs, affecting how they process and produce text.

ChatGPT is highly customizable, providing users the ability to fine-tune its responses and behavior, while other NLP models may have limited customization or strict behavior and output. It is a unique and robust NLP model and is ideal for applications requiring conversational interactions and realistic-sounding text[7]. Its flexibility and customization make it a valuable tool for a wide range of applications. Overall, ChatGPT is a unique and powerful NLP model that is well-suited for applications that require realistic-sounding text generation and conversational interactions[8]. It offers a high degree of flexibility and customization, making it a valuable tool for a wide range of applications.

It is worth noting that Chat GPT is presently in beta. The argument is that ChatGPT can program, explain, and debate effectively and like a person. The website clearly states that it may provide misleading, obviously false information. When tested in precise ways, it has been shown to induce prejudice material. There are instances of ChatGPT responses that read like they were authored by experts but are factually inaccurate[9].

Students will eventually be able to employ AI technologies to study new material. Teachers will require tools and resources to support students in identifying and navigating possible incorrect responses, biased information, and false news if this is to take place.

Although chatbots have been around for the past 20 years, they had certain limits when it came to their capacity to teach complicated subjects like quantum physics or produce original works like ballads. Unprecedented AI technological advancements have been made by Chat GPT.

ChatGPT may challenge Google's current dominance of the internet search market, although the tech giant has been developing a comparable technology for years. Microsoft made a billion-dollar investment in Open AI in 2020, taking up the sole license for the GPT-3 model. Microsoft wants to include the technology into popular productivity suites including Word, PowerPoint, and Excel. In November 2022, GPT 3.5 had been upgraded through 2021 and had been made freely available to the public as a chatbot. Chat GPT amassed 100 million members only two months after its introduction, dwarfing other social media sites like Instagram, which took two years to reach that number.

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## III. ADVANTAGES OF CHATGPT

- Improved language understanding: NLP models can help students learn new languages or improve their understanding of existing languages by providing detailed analysis and feedback on grammar, syntax, and vocabulary usage.
- Enhanced writing skills: NLP models can help students improve their writing skills by providing suggestions and feedback on the content, structure, and style of their written work[10].
- Increased accessibility: NLP models can help make education more accessible to students with disabilities by providing text-to-speech and speech-to-text capabilities, allowing them to access and interact with educational materials in a format that suits their needs.

## IV. DISADVANTAGES OF CHATGPT

- Chatbots are not able to think and solve problems in the same way that humans enjoy. They can only provide pre-programmed answers to common inquiries, and they cannot analyze complex situations and make decisions based on incomplete or ambiguous information. This limits its ability to deal with situations that occur outside the scope of its programming.
- Chatbots cannot understand human emotions and experiences. While it can mimic human language and provide adequate and useful answers, it is impossible to empathize with users in the same way a human would[11]. That's because chatbots run on algorithms and data, while humans have subjective emotions and experiences that shape their thoughts and actions.
- Chatbots cannot have empathy on the part of the person responding to the users.
- Chatbots deliver automatic responses without resolution.
- Chatbots deliver non-customized solutions, without considering the needs of each user[10].

## V. AI IN AIDING EDUCATORS AND STUDENTS

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If utilized properly, AI may be a useful tool for teachers and students. Chat GPT can assist instructors in creating individualized lesson plans based on each student's areas of strength and weakness, enabling a more focused and successful educational experience[12]. Additionally, AI can point out areas in which pupils may be having difficulty and offer specialized resources to assist them to succeed. It can complete all data analysis tasks that take people days to complete in a matter of seconds. As a consequence, teachers have less work to do and more time to spend interacting with their pupils.

For students who might not have access to the same resources as their peers, AI can help level the playing field. The achievement gap may be closed by using Chat GPT, which enables students from underprivileged backgrounds to receive the same amount of individualized attention and assistance as those from more fortunate situations[13].

It's critical to remember that AI cannot solve every problem in education. It is still the responsibility of teachers and administrators to guarantee that children receive a well-rounded education[14] that emphasizes teamwork, problem-solving, and critical thinking. While AI can help with some parts of education, it cannot take the place of human interaction and engagement, which are essential for real learning to take place.

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AI can't replace human creativity, but it doesn't mean it has no place in the classroom or education system. Rather than being insecure about the use of ChatGPT by the students, teachers should focus on how this AI would help students to systematically arrange their unorganized thoughts on paper. Teachers should use AI as another pedagogical tool for students[15]. Just like teachers give a grounding in students to send emails and how to do proper research on Google search engine. Educators should compose clear lessons around how the ChatGPT bot can assist with essay writing. Acknowledging AI's existence and helping students work with it could restructure the teaching and learning process. Teachers should also teach students to give proper and ethically correct instructions to AI rather than Asking AI for a fabricated essay without any idea or thought in mind about how students should focus on the construction of outlines, templates, and instructions by using ChatGPT. Experts say ChatGPT has the potential to offer students a base and skeleton for any writing project.

Instead of Considering ChatGPT as an apocalyptic shift toward the future, we should focus on how we can make the best out of it. Nowadays technology is evolving fast and we're the people living in the future. Rather than blocking and banning this new technology, we should work with its astonishing ability to improve writing and research. AI has the potential to greatly assist us in every walk of life. It's important to note that AI is not a replacement for human creativity and critical thinking. AI can help with mechanics, but it cannot replace the unique perspective and insights that a human can bring to their work. Artificial intelligence, algorithms, and machine learning are here to stay, and it is our responsibility to accommodate them with virtue[16].

## VI. AI IN ACADEMIC WRITING

Chatbots have the potential to transform education by providing instant assistance to students, answering their questions, and improving their learning experience. Numerous new technologies have rendered previous technologies obsolete, and Chat GPT can write almost anything that is required of it. Many argue that copying what an artificial intelligence creates into a cover letter, blog post, or essay is unethical, dishonest, and AI plagiarism. Academic institutions will have to evolve compatible methods to evaluate students learning gaps and future potential[17]. We need to modify the way we educate writing, critical thinking, and research skills. Artificial authoring tools like Chat GPT will accelerate this shift. It is already capable of addressing genre writing (argumentative, narrative, and informational genres). It can do all of this swiftly, effortlessly, and efficiently[18].

Chat GPT, for example, will move our attention in academic writing away from acquiring techniques for teaching personal stories, and informational, and argumentative writing. Instead, we may use websites, interactive presentations, videos, infographics, podcasts, blog entries, digital art, and other new and evolving media formats to educate critical thinking, revision, research, discussion, and creatively organize ideas. But it is important to note that humans are still required to review and correct AI-generated texts. That editing is often complicated and requires real knowledge of a subject[19].

Chat GPT, on the other hand, may become a writing coach or personal tutor for students. Students might obtain feedback from this technology in seconds rather than waiting for teacher comments[20]. Allowing students to utilize Chat GPT to seek comments on their writing has a lot of potential benefits. Students can ask the AI to perform certain activities such as reviewing and correcting their papers. Before beginning a writing unit, students should complete an on-demand writing assignment and use Chat GPT to receive comments. On-demand writing requires students to go through the whole writing process and complete a piece of writing in one class hour without assistance from the teacher or AI technologies.

## VII. WRITING ASSESSMENT

Teachers and administrators should consider using this AI technology as a writing coach that offers pupils with rapid feedback. It might lead to faster learning and better student writing. ChatGPT's ability to offer a concise overview of a piece of writing and even grade it is a huge advantage. ChatGPT can use data such as a student's learning history and preferences to tailor its responses and recommendations[21].

This tool may be extremely useful if a teacher was searching for a second opinion on a student's writing to calibrate their evaluation process. Instructors might also ask students to first receive input from the AI and edit based on that feedback before submitting the paper; this could be highly beneficial to both students and teachers[22]. It can offer students immediate feedback. A student's replies may be analyzed using ChatGPT, and real-time feedback can be given. Students' learning results can be enhanced by using this to assist them pinpoint their strengths and shortcomings. Students may learn from their mistakes and improve their writing abilities by using ChatGPT to offer comments on their written assignments and make adjustments and improvements[23].

If Chat GPT is used as a co-teaching tool rather than a plagiarism tool, it can help students revise their work[24]. Students may begin the revision process as they have a piece of writing in front of them, modifying the work as they collaborate with Chat Talk. This would shift the focus from writing more towards revision and editing. Potentially, it can help accelerate student experience with revision and editing[25].

Some students have been candid about utilizing technology to assist them in producing flawless academic language in their writing. It's like everyone gets free ghostwriting, yet there are instances where ChatGPT's comments are demonstrably false.

## VIII. CRITICAL THINKING

Critical thinking is the capacity to distinguish between fact and opinion while remaining open to diverse points of view. It is also the ability to arrange all of the knowledge that has been learned into something cohesive and intelligible It's not only for writing, anyway. It may involve reading, talking about, and arguing. Writing is a crucial component of academic instruction because it aids certain students in organizing the knowledge they acquire. But in addition to writing, there are other ways to organize thoughts, such as speaking, sketching, and making art.

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Reliance on such technologies does not foster the kind of critical thinking and problem-solving abilities necessary for success in school and life. Students' capacity to think creatively and independently may diminish over time. Students that rely too much on Chat GPT may lose interest in learning independently, which may eventually lead to a decline in the human intellect. Striking a balance between the use of technology and more conventional teaching approaches is crucial. Additionally, not all of the answers provided by Chat GPT would be reliable[26]. Students could then use erroneous results as the foundation for judgments as a result of this. Their schooling and future professions can suffer as a result of this.

## IX. ENGAGEMENT

Chatbots, like ChatGPT, can raise student interest in learning by delivering dynamic and interesting learning opportunities. Multimedia tools like films and photos may be used by chatbots to make learning more exciting and engaging. To make learning more entertaining, ChatGPT may also employ gamification tactics like tests and challenges[27]. Additionally, ChatGPT may give students immediate feedback on their development and accomplishments, inspiring them to keep learning and growing.

It is concerning because gullible educators can believe that they have delivered an amazing lesson plan if all of their students turn in flawless assignments. whereas ChatGPT or a comparable technology is responsible for everything. If pupils begin to rely too much on technology, academic standards may deteriorate. If students quit teaching themselves how to write essays and switch to ChatGPT[30].

## X. COPYRIGHT ISSUES RELATED TO CHATGPT

When utilizing ChatGPT or any similar language model, it is crucial to remain cognizant of copyright concerns. Copyright law safeguards original works of authorship, encompassing literary, dramatic, musical, and artistic creations, against unauthorized usage without the copyright holder's consent. Consequently, incorporating any copyrighted content into interactions with ChatGPT may potentially result in infringement upon the rights held by the copyright holder. [28].

It is essential to recognize that the outcomes produced by ChatGPT do not automatically grant the freedom of use. Similar to other forms of content, these generated results might be subject to copyright protection. As a result, prior permission from the copyright holder may be necessary before utilizing the results in any manner.[23].

It is also worth noting that ChatGPT is a large language model trained by OpenAI, and as such, it is not intended to be used for any commercial purposes. Using the results generated by ChatGPT for commercial purposes is a violation of OpenAI's terms of service[29].

To ensure compliance with copyright regulations and prevent any infringement upon the rights of copyright holders, it is crucial to restrict the usage of content in interactions with ChatGPT to those for which the necessary usage rights have been obtained. Such content may include self-created materials, works within the public domain, or content that is licensed for use under licenses such as Creative Commons or other licenses explicitly permitting its utilization.

In the context of utilizing content within interactions with ChatGPT, it is prudent to exercise caution when determining whether a specific piece of content is safeguarded by copyright or if the right to employ it is granted. To maintain compliance with copyright laws, it is advisable to err on the side of caution and obtain permission from the copyright holder. By doing so, one can ensure the avoidance of any potential legal ramifications associated with infringement and uphold the rights of all parties involved.[31].

In a broader context, exercising caution when utilizing the outcomes produced by ChatGPT or any comparable language model is strongly advised. When uncertain about the legitimacy of using ChatGPT's results, it is recommended to seek permission from the copyright holder, or alternatively, employ content that falls within the public domain or is licensed under Creative Commons or other licenses that explicitly permit its usage. By adopting these measures, one can ensure compliance with copyright regulations and mitigate any potential legal complexities associated with unauthorized usage of content.

## XI. BIAS IN AI

Ethics and biases should be of great concern not just to Chat GPT but also to any other chatbot. Biases in chatbots may affect their suggestions and answers[32], [33]. Make sure that chatbots are trained on objective facts and be open and honest about how the chatbot functions. Complex issues involving people may receive insensitive answers since human emotions have little bearing on how Chat GPT functions. This undermines empathy and ruins interpersonal relationships[34].

Bias and prejudice are dangerous traits of AI. If not trained on fair and balanced data, it can produce biased results that are skewed towards particular opinions. With lack of explainability, it is difficult to determine whether ChatGPT can produce unbiased opinions based on various topics.

To effectively integrate ChatGPT into teaching and learning practices, universities should start with a small pilot program to test the effectiveness of ChatGPT in their specific context. And ensure that their chatbot is trained on unbiased data and that it is transparent about how it works. Universities should provide training to faculty and students on how to use the chatbot effectively and monitor and evaluate its effectiveness regularly.

## XII. PRIVACY CONCERNS AND DATA LEAKS

One of the main concerns associated with using chatbots in education is privacy. Chatbots collect a large amount of data about users, including their personal information and learning history.

Certain users were able to read the titles of other users' talks due to a ChatGPT bug. Nonetheless, many people are still concerned about their privacy on the network. Since its inception in November of last year, millions of individuals have used ChatGPT to compose messages, make music, and even code. Each interaction with the chatbot is saved in the user's chat history bar and may be accessed at any time.

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The bug appeared to imply that Open AI has access to user communications. According to the company's privacy policies, user data such as prompts and replies may be utilized to continue training the model. Nevertheless, that information is only utilized once any personally identifying information has been deleted. It is important to ensure that this data is protected and used ethically[35].

Google and Microsoft, which have invested heavily in Open AI, have been vying for dominance in the emerging market for artificial intelligence technologies. Yet, given the rapid speed of new product upgrades and releases, many people are concerned that mistakes like this might be damaging or have unforeseen repercussions.

## XIII. STATISCS ON PLAIGARISM

The British University in Egypt has conducted an internal investigation into its' undergrad students' submissions. Using the tool "Turnitin", it was found that there is a staggering content of AI generated work in submissions. The investigation was done across 9 faculties. Each of which had at least one module that was examined using this plagiarism and AI checking tool.

Examining figure 1, the faculty of mass media has scored the highest average of plagiarism across all faculties with 66 percent. The faculty of environmental engineering, nursing and informatics and computer science have scored similarly with an average score of 64, 61 and 60 percent respectively. The faculty of political science has scored the lowest plagiarism percentage at 28 percent. The second lowest percentage was achieved by the faculty of engineering and law. Both scored an average of 42 percent.

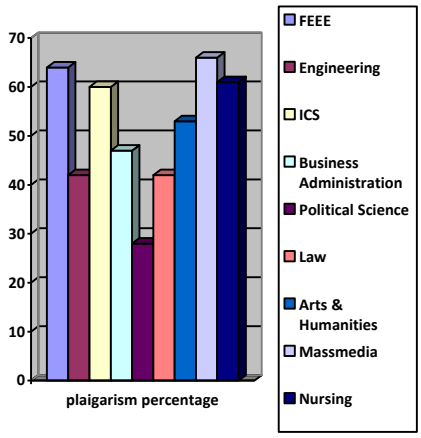


**Figure 1**

The university has taken drastic measures towards the plagiarizing students. Also, the university ensures that such a major incident does not get repeated. AI tools are becoming more accessible and without aid from plagiarism checking tools, these submissions would go undetected.

## XIV. DISCUSSION

The faculty of informatics and computer science at the British University in Egypt surveyed ChatGPT in education. The survey aims to gather feedback from faculty regarding the integration of AI-based language models, specifically ChatGPT, into undergraduate education. The survey covers a wide range of aspects, including potential benefits, challenges, and ethical considerations associated with using ChatGPT in educational settings.

One of the key areas explored in the survey is the potential benefits of using ChatGPT in undergraduate education. The options provided encompass various positive impacts, such as increased access to information and resources, enhanced student engagement and participation, improved understanding of complex topics, and personalized learning experiences. These potential benefits reflect the versatility of ChatGPT as a tool that can supplement traditional teaching methods, provide tailored support to students, and foster interactive learning environments.

Another crucial aspect addressed by the survey is the anticipated challenges or limitations of using ChatGPT in undergraduate education. The options provided cover important concerns, including the reliability and accuracy of responses generated by ChatGPT, assessing students' original thinking in the context of AI-generated content, potential biases in the model's outputs, and ethical considerations related to AI use. These anticipated challenges highlight the need for careful implementation and monitoring of ChatGPT to mitigate potential drawbacks and ensure its responsible integration in education.

The survey also explores how ChatGPT can enhance student engagement, participation, critical thinking, and problem-solving skills. The options provided include encouraging shy or introverted students to participate, facilitating interactive discussions and debates, providing immediate feedback and support, and promoting diverse perspectives and insights. These potential benefits align with the interactive and adaptive nature of ChatGPT, suggesting that it can contribute to creating more inclusive and dynamic learning environments while fostering critical thinking and problem-solving abilities.

Moreover, the survey delves into potential concerns and ethical considerations regarding the use of ChatGPT in undergraduate education. The options provided include concerns such as dependence on AI and reduced human interaction, authenticity and originality of students' work, data privacy and security, and the presence of unconscious bias in AI-generated content. These concerns highlight the importance of responsible AI use, transparency, and ongoing evaluation to ensure ethical practices in the integration of ChatGPT in education.

The survey also enquires about the integration of ChatGPT into undergraduate courses, specific use cases, impacts on teaching approaches and classroom dynamics, and observed changes in students' learning outcomes or performance. These questions provide valuable insights into the practical implementation of ChatGPT and its effects on teaching practices and student outcomes, enabling a comprehensive understanding of its efficacy in different educational contexts.

Lastly, the survey addresses the availability of training or professional development opportunities for faculty to effectively use ChatGPT in teaching. It also solicits suggestions for additional support or resources that would help utilize ChatGPT more effectively in undergraduate courses. These questions highlight the importance of

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providing faculty with appropriate training and resources to maximize the benefits of ChatGPT and address any potential challenges they may encounter.

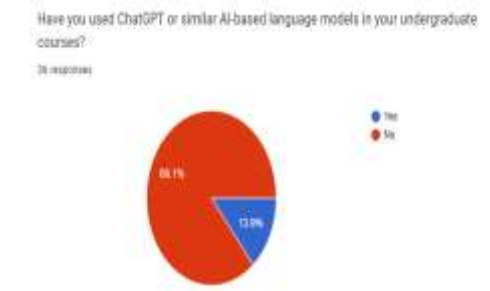


**Figure 2**

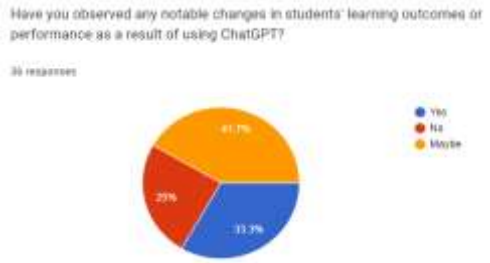


**Figure 3**

Based on the survey conducted on faculty staff, the majority have admitted that they utilized ChatGPT in their undergraduate graduate courses in one way or another as shown in Figure 1. Figure 2 above shows that academic staff is still undecided about if ChatGPT has affected the learning outcomes and the performance of students. Figure 3 below shows that despite the potential negative effects that a tool like this can have on the teaching and learning process. Most of the academic staff would still recommend using that tool in education. This suggests that large language models like these could be positively integrated into education.

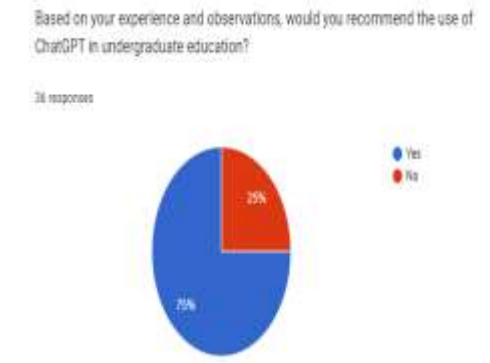


**Figure 4**

## XV. CONCLUSION

While AI technologies are becoming inevitable, they are still being developed to help humans. Therefore, to face the fear of its transformation into a substitute for humans, it is better to take advantage of artificial intelligence, rather than allow it to rule over. Concern over artificial intelligence's potential effects on education and the future of academics has grown as technology continues to advance quickly. Some worry that depending too much on AI, such as Chat GPT, may produce a generation of kids who are incapable of critical thought and cannot think for themselves.

The research demonstrates that AI may be a useful tool in the classroom, despite some people's concerns that technology-dependent pupils would be produced by AI like Chat GPT. as long as teachers keep making critical thinking and interpersonal connection a priority. All students' educational experiences may be improved and enhanced with the aid of AI.

While AI can help with activities like essay writing and simple question answering, it cannot take the place of the nuanced thinking and analysis needed for higher-level learning. Students still need to come up with their ideas, participate in conversations and disagreements, and push themselves to think critically about the world. The effect of Chat GPT on the direction of education is still a cause for alarm. The early casualty would be particularly the capacity for thought. Future difficulties may not be able to be precisely predicted at this time.

## XVI. REFRENCES


[1] P. P. Ray, "ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope," *Internet of Things and Cyber-Physical Systems*, vol. 3, pp. 121–154, Jan. 2023, doi: 10.1016/j.iotcps.2023.04.003.

[2] R. Gozalo-Brizuela and E. C. Garrido-Merchan, "ChatGPT is not all you need. A State of the Art Review of large Generative AI models." arXiv, Jan. 11, 2023. doi: 10.48550/arXiv.2301.04655.

[3] J. Kocoń *et al.*, "ChatGPT: Jack of all trades, master of none," *Information Fusion*, vol. 99, p. 101861, Nov. 2023, doi: 10.1016/j.inffus.2023.101861.

[4] B. Bembi, "The Brilliance and Weirdness of ChatGPT," *Medium*, May 18, 2023. https://ai.plainenglish.io/the-brilliance-and-weirdness-of-chatgpt-67ee118b046c (accessed Jul. 16, 2023).

[5] M. U. Haque, I. Dharmadasa, Z. T. Sworna, R. N. Rajapakse, and H. Ahmad, "'I think this is the most disruptive technology': Exploring Sentiments of ChatGPT Early Adopters using Twitter Data." arXiv, Dec. 12, 2022. doi: 10.48550/arXiv.2212.05856.

[6] B. Gordijn and H. ten Have, "ChatGPT: evolution or revolution?," *Med Health Care and Philos*, vol. 26, no. 1, pp. 1–2, Mar. 2023, doi: 10.1007/s11019-023-10136-0.

[7] V. Taecharungroj, "'What Can ChatGPT Do?' Analyzing Early Reactions to the Innovative AI Chatbot on Twitter," *Big Data and Cognitive Computing*, vol. 7, no. 1, Art. no. 1, Mar. 2023, doi: 10.3390/bdcc7010035.


Electronic copy available at: https://ssrn.com/abstract=4532913

[8] G. Cooper, "Examining Science Education in ChatGPT: An Exploratory Study of Generative Artificial Intelligence," *J Sci Educ Technol*, vol. 32, no. 3, pp. 444–452, Jun. 2023, doi: 10.1007/s10956-023-10039-y.

[9] J. Wang *et al.*, "On the Robustness of ChatGPT: An Adversarial and Out-of-distribution Perspective." arXiv, Mar. 29, 2023. doi: 10.48550/arXiv.2302.12095.

[10] J. Deng and Y. Lin, "The Benefits and Challenges of ChatGPT: An Overview," *Frontiers in Computing and Intelligent Systems*, vol. 2, no. 2, Art. no. 2, 2022, doi: 10.54097/fcis.v2i2.4465.

[11] A. Borji, "A Categorical Archive of ChatGPT Failures." arXiv, Apr. 03, 2023. doi: 10.48550/arXiv.2302.03494.

[12] A. M. A. Ausat, B. Massang, M. Efendi, N. Nofirman, and Y. Riady, "Can Chat GPT Replace the Role of the Teacher in the Classroom: A Fundamental Analysis," *Journal on Education*, vol. 5, no. 4, Art. no. 4, Apr. 2023, doi: 10.31004/joe.v5i4.2745.

[13] B. D. Lund and T. Wang, "Chatting about ChatGPT: how may AI and GPT impact academia and libraries?," *Library Hi Tech News*, vol. 40, no. 3, pp. 26–29, Jan. 2023, doi: 10.1108/LHTN-01-2023-0009.

[14] S. Biswas, "Role of Chat GPT in Education." Rochester, NY, Feb. 25, 2023. Accessed: Jul. 16, 2023. [Online]. Available: https://papers.ssrn.com/abstract=4369981

[15] M. Shidiq, "THE USE OF ARTIFICIAL INTELLIGENCE-BASED CHAT-GPT AND ITS CHALLENGES FOR THE WORLD OF EDUCATION; FROM THE VIEWPOINT OF THE DEVELOPMENT OF CREATIVE WRITING SKILLS," *PROCEEDING OF INTERNATIONAL CONFERENCE ON EDUCATION, SOCIETY AND HUMANITY*, vol. 1, no. 1, Art. no. 1, May 2023.

[16] C. Macdonald, D. Adeloye, A. Sheikh, and I. Rudan, "Can ChatGPT draft a research article? An example of population-level vaccine effectiveness analysis," *J Glob Health*, vol. 13, p. 01003, doi: 10.7189/jogh.13.01003.

[17] N. Curtis and ChatGPT§, "To ChatGPT or not to ChatGPT? The Impact of Artificial Intelligence on Academic Publishing," *The Pediatric Infectious Disease Journal*, vol. 42, no. 4, p. 275, Apr. 2023, doi: 10.1097/INF.0000000000003852.

[18] A. Tlili *et al.*, "What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education," *Smart Learn. Environ.*, vol. 10, no. 1, p. 15, Feb. 2023, doi: 10.1186/s40561-023-00237-x.

[19] X. Zhai, "ChatGPT User Experience: Implications for Education." Rochester, NY, Dec. 27, 2022. doi: 10.2139/ssrn.4312418.

[20] C. Wu, S. Yin, W. Qi, X. Wang, Z. Tang, and N. Duan, "Visual ChatGPT: Talking, Drawing and Editing with Visual Foundation Models." arXiv, Mar. 08, 2023. doi: 10.48550/arXiv.2303.04671.

[21] B. D. Lund, T. Wang, N. R. Mannuru, B. Nie, S. Shimray, and Z. Wang, "ChatGPT and a new academic reality: Artificial Intelligence-written research papers and the ethics of the large language models in scholarly publishing," *Journal of the Association for Information Science and Technology*, vol. 74, no. 5, pp. 570–581, 2023, doi: 10.1002/asi.24750.

[22] H. H. Thorp, "ChatGPT is fun, but not an author," *Science*, vol. 379, no. 6630, pp. 313–313, Jan. 2023, doi: 10.1126/science.adg7879.

[23] C. A. Gao *et al.*, "Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers." bioRxiv, p. 2022.12.23.521610, Dec. 27, 2022. doi: 10.1101/2022.12.23.521610.

[24] S. B. Patel and K. Lam, "ChatGPT: the future of discharge summaries?," *The Lancet Digital Health*, vol. 5, no. 3, pp. e107–e108, Mar. 2023, doi: 10.1016/S2589-7500(23)00021-3.

[25] M. Khalil and E. Er, "Will ChatGPT get you caught? Rethinking of Plagiarism Detection." arXiv, Feb. 08, 2023. doi: 10.48550/arXiv.2302.04335.

[26] N. Fijačko, L. Gosak, G. Štiglic, C. T. Picard, and M. J. Douma, "Can ChatGPT pass the life support exams without entering the American heart association course?," *Resuscitation*, vol. 185, Apr. 2023, doi: 10.1016/j.resuscitation.2023.109732.

[27] A. Haleem, M. Javaid, and R. P. Singh, "An era of ChatGPT as a significant futuristic support tool: A study on features, abilities, and challenges," *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, vol. 2, no. 4, p. 100089, Oct. 2022, doi: 10.1016/j.tbench.2023.100089.

[28] E. L. Hill-Yardin, M. R. Hutchinson, R. Laycock, and S. J. Spencer, "A Chat(GPT) about the future of scientific publishing," *Brain Behav Immun*, vol. 110, pp. 152–154, May 2023, doi: 10.1016/j.bbi.2023.02.022.

[29] H. Hassani and E. S. Silva, "The Role of ChatGPT in Data Science: How AI-Assisted Conversational Interfaces Are Revolutionizing the Field," *Big Data and Cognitive Computing*, vol. 7, no. 2, Art. no. 2, Jun. 2023, doi: 10.3390/bdcc7020062.

[30] D. Mhlanga, "Open AI in Education, the Responsible and Ethical Use of ChatGPT Towards Lifelong Learning." Rochester, NY, Feb. 11, 2023. doi: 10.2139/ssrn.4354422.

[31] M. J. Ali and A. Djalilian, "Readership Awareness Series – Paper 4: Chatbots and ChatGPT - Ethical Considerations in Scientific Publications," *Seminars in Ophthalmology*, vol. 38, no. 5, pp. 403–404, Jul. 2023, doi: 10.1080/08820538.2023.2193444.

[32] T. Y. Zhuo, Y. Huang, C. Chen, and Z. Xing, "Red teaming ChatGPT via Jailbreaking: Bias, Robustness, Reliability and Toxicity." arXiv, May 29, 2023. doi: 10.48550/arXiv.2301.12867.

[33] R. W. McGee, "Is Chat Gpt Biased Against Conservatives? An Empirical Study." Rochester, NY, Feb. 15, 2023. doi: 10.2139/ssrn.4359405.

[34] S. Biswas, "The Function of chat GPT in Social Media: According to chat GPT." Rochester, NY, Mar. 30, 2023. doi: 10.2139/ssrn.4405389.

[35] M. G. Southern, "Massive Leak Of ChatGPT Credentials: Over 100,000 Accounts Affected," *Search Engine Journal*, Jun. 20, 2023. https://www.searchenginejournal.com/massive-leak-of-

Electronic copy available at: https://ssrn.com/abstract=4532913

chatgpt-credentials-over-100000-accounts-affected/489801/ (accessed Jul. 17, 2023).

Electronic copy available at: https://ssrn.com/abstract=4532913